EDITORIAL

Aspiration thrombectomy and primary percutaneous coronary intervention

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How beneficial is the adjunctive use of thrombectomy devices in STEMI patients undergoing primary angioplasty?

The adoption of pharmacological and/or mechanical reperfusion therapies has contributed to improve the outcome of patients with ST segment elevation myocardial infarction (STEMI).[1–3] However, despite successful epicardial recanalisation, suboptimal myocardial reperfusion may occur, resulting in an unfavourable outcome.[4 5] Mounting interest has emerged in the role of distal embolisation in the determination of poor reperfusion. In fact, distal embolisation may occur in up to 16% of patients undergoing primary angioplasty.[6] Several thrombectomy devices have been proposed to prevent distal embolisation, such as AngioJet (Possis Medical, Minneapolis, Minnesota, USA), X-Sizer (eV3, Plymouth, Maine, USA), Rescue (Boston Scientific, Maple Grove, Maine, USA), Export Catheter (Medtronic, Santa Rosa, California, USA), Diver CE (Invatec, Roncadelle, Italy), Pronto Catheter (Vascular Solution, Minneapolis, USA), Rinspiration System (Kerberos Proximal Solutions, Cupertino, California, USA), and TVAC (thrombus vacuum aspiration catheter) (Nipro, Japan). The strategy of adding these devices seems very attractive for improving reperfusion and survival after primary angioplasty for STEMI.

An additional potential advantage of thrombectomy in STEMI is that it may help to define the stenosis and facilitate a strategy of direct stenting, that may counterbalance the initial higher costs and offer additional advantages in terms of distal microembolisation and myocardial perfusion.[7 8]

MANUAL ASPIRATION THROMBECTOMY

In this context, De Luca and colleagues[9] report in this issue of *Heart* the results of their randomised trial to investigate the impact of adjunctive use of manual aspiration thrombectomy (Diver) on myocardial perfusion and left ventricular remodelling. A total of 78 patients with anterior STEMI and clear angiographic evidence of intracoronary thrombus were randomised to conventional primary percutaneous coronary intervention (PCI) versus adjunctive aspiration thrombectomy. All patients were treated with stenting and glycoprotein IIb/IIIa inhibitors. The primary end point of the study was left ventricular remodelling. This trial showed significant benefits with adjunctive thrombectomy in terms of myocardial perfusion (evaluated by ST segment resolution and myocardial blush) and left ventricular remodelling, without benefits in clinical outcome. Interestingly, the use of thrombectomy largely favoured a strategy of direct stenting (92.1% *v* 5.3% in control group).

Several limitations in the interpretation of the results of this study must certainly be commented on. This is a small trial, without any mention of statistical power and calculation of sample size. Thus, the decision to include only 78 patients was completely unclear. Because of the small sample size, no conclusion can be drawn in terms of clinical outcome, even though the surrogate end point of left ventricular remodelling may imply a worse long-term survival in patients undergoing conventional primary angioplasty. Furthermore, left ventricular remodelling was evaluated by standard echocardiographic examination, whereas the additional use of contrast agents or magnetic resonance imaging (MRI) would certainly have improved the study quality and results. Finally, no data have been reported in terms of inter- and intraobserver variability concerning myocardial blush grade (MBG) and ST segment analysis.

TRIAL FINDINGS: CONFLICTING RESULTS

However, this trial provides additional data on a very important and still controversial issue. Since the Zwolle group has shown the clinical relevance of distal embolisation in primary angioplasty,[6] several trials have been conducted with different thrombectomy devices (table 1) resulting in conflicting results.[9–20] Negative results have mostly been observed in two large trials.[15 16]

In the AIMI multicentre trial,[15] a total of 480 patients were randomised to rheolytic thrombectomy with Angiojet versus conventional primary angioplasty. The primary end point was infarct size estimated by technetium-99m sestamibi. This trial showed a paradoxically larger infarct size and higher mortality in patients treated with thrombectomy in comparison with conventional primary angioplasty. However, several factors may certainly explain the negative results of this trial, including the low rate of anterior infarction (around 35%), a larger use of

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Abbreviations: MBG, myocardial blush grade; PCI, percutaneous coronary intervention; STEMI, ST segment elevation myocardial infarction; TIMI, Thrombolysis In Myocardial Infarction; TVAC, thrombus vacuum aspiration catheter

Table 1 Characteristics of randomised trials

	Period	n	Study device	TCL	Gp IIb/IIIa	Stent	I endpoint	Results	30 day mortality*
Napodano[11]	2000–2001	92	X-sizer	Yes	42.4%	92.4%	MBG	+	6.5%
Antoniucci[13]	2002–2003	100	Angiojet	No	98%	98%	STSR	+	0
X-AMINE[14]	NA	201	X-sizer	Yes	60%	NA	STSR	+	4.0%
REMEDIA[17]	2004	99	Diver	No	65.6%	NA	MBG/STSR	+	6.3%
Dudek[12]	NA	72	Rescue catheter	Yes	0	NA	NA	+	NA
De Luca[8]	NA	78	Diver	Yes	100%	100%	LV remodelling	+	5.2%
AIMI [15]	NA	480	Angiojet	No	94.5%	94%	Infarct size	−	0.8%
Beran[10]	2000–2001	61	X-sizer	No	54%	NA	cTFC	+	3.2%
Dear MI[19]	2004–2005	148	Pronto catheter	No	100%	100%	STSR/MBG	+	0
Export study[18]	2004–2005	50	Export catheter	No	NA	NA	STSR	+	3.8%
Kaltoft[16]	NA	215	Rescue catheter	No	94.5%	96%	Infarct size	−	1.8%
VAMPIRE[20]	2004–2005	368	TVAC	No	0	93%	MBG	+	0.7%

cTFC, corrected TIMI frame count; Gp, glycoprotein; LV, left ventricular; MBG, myocardial blush grade; NA, not available; STSR, ST segment resolution; TCL, thrombus-containing lesions (as inclusion criteria); TVAC, thrombus vacuum aspiration catheter.
*Control group.

temporary pacemaker in patients randomised to thrombectomy (58% *v* 19%), the large prevalence of preprocedural recanalisation (preprocedural TIMI 3 flow was more frequently observed in the control group (27%) than in patients randomised to thrombectomy (19%)), and the very low rate of patients with evidence of thrombus.

In a Danish single centre trial,[16] a total of 215 STEMI patients were randomised to mechanical thrombectomy by the Rescue catheter or conventional primary angioplasty. Also in this study patients were not selected on the basis of angiographic evidence of thrombus. Enzymatic infarct size—the primary study end point—was, in accordance with the AIMI trial, paradoxically larger in patients randomised to thrombectomy. No benefits were observed in terms of ST segment resolution.

Opposite findings have been observed in the VAMPIRE trial, that was presented during the 2005 annual meeting of the American Heart Association.[20] A total of 368 patients were randomised to TVAC (n = 188) or conventional primary angioplasty (n = 180). Adjunctive thrombectomy was associated with better myocardial perfusion and less distal embolisation, despite no impact being observed on 30-day survival.

In accordance with the VAMPIRE trial, several small randomised studies,[9 11–12 14] including the study by De Luca *et al*,[9] have shown that thrombectomy devices significantly improve myocardial perfusion (evaluated by MBG and ST segment resolution) and reduce distal embolisation.

Several factors should be taken into account in the interpretation of the conflicting results of current available trials before final conclusions on the benefits from these devices in the treatment of STEMI patients can be drawn.

- It seems unlikely that adjunctive therapy for STEMI would further reduce the very low mortality rate already achieved after primary angioplasty. This is even more relevant when high-risk patients are excluded, due to the strict patient selection procedure commonly adopted in many randomised trials (table 1). Furthermore, myocardial perfusion affects left ventricular remodelling and long-term mortality, whereas only 30-day mortality was available in the vast majority of trials.
- The studies are certainly heterogeneous due to differences in inclusion and exclusion criteria and devices.
- MBG and ST segment resolution represent less objective end points as compared to enzymatic infarct size evaluated by scintigraphic techniques. Data on MBG have been reported thus far from specialised angiographic laboratories, with angiograms both performed and interpreted by experts in the field. Furthermore, a large variability is observed in the definition and analysis of ST segment resolution across trials (ST segment analysed at 20, 60 or 80 ms from J point and at 30, 60 or 90 minutes after the procedure; complete resolution defined as more than 50% or 70%).
- A key issue in the use of thrombectomy devices is the selection of patients. In fact, even though the mechanism involved in acute coronary occlusion and acute myocardial infarction is represented in the majority of patients by plaque rupture with superimposition of thrombus, in clinical practice the thrombotic burden may be extremely variable across patients.
- These mechanical devices would not be able to completely prevent distal embolisation, since they may mechanically induce distal embolisation when crossing the thrombotic lesions, as shown by the paradoxically larger infarct size in the Danish trial and in the AIMI trial.[15] This is mainly due to the profile of the device.
- Finally, it should be kept in mind that distal embolisation is not the only determinant of infarct size and poor reperfusion. Other mechanisms include increased microcirculatory resistance due to neutrophil obstruction of microcirculation and/or constriction of arterioles, progressing myocardial oedema, and myocardial injury after reperfusion.[21] Thus, adjunctive mechanical devices cannot be expected to be, by preventing distal embolisation, the only key solution to improve myocardial reperfusion during primary angioplasty for acute myocardial infarction. Time-to-treatment has recently been shown to affect infarct size, myocardial perfusion and long-term mortality.[22 23] Early pharmacological reperfusion and good regional networks with early diagnosis, risk stratification and direct transportation to the cath lab may certainly contribute to reducing infarct size further and improving survival.[24–28]

In conclusion, the study by De Luca *et al* adds a little body of evidence in favour of adjunctive use of thrombectomy in selected patients with STEMI treated by primary angioplasty. The patient's coronary anatomy and risk profile, as well as economic considerations, must be taken into account when deciding whether these devices should be used or not. Until data from additional larger randomised trials become available, the adjunctive use of thrombectomy devices in primary angioplasty for STEMI may not routinely be recommended, except in the case of evident large thrombotic burden.

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IMAGES IN CARDIOLOGY

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Arterial supply to left arm via patent left internal mammary artery graft

A 66-year-old woman presented with recurrent angina. Her previous history included two previous myocardial infarctions followed by four vessel coronary bypass surgery (CABG) in 1995. Angiography demonstrated three patent vein grafts. On attempting to image the left internal mammary artery (LIMA) it proved impossible to pass a catheter up the left subclavian artery (LSA). Angiography showed occlusion of the LSA. However, on cannulating the native left coronary circulation the LIMA graft was widely patent and filling retrogradely to perfuse the left arm (see panel). On further questioning the patient admitted experiencing pain in her left arm on moving this limb. Blood pressure in her left arm (149/76 mm Hg) was lower than her right (184/99 mm Hg).

We believe this to be the first reported case of this type with a LIMA graft effectively functioning in a retrograde manner to supply the left arm.

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